

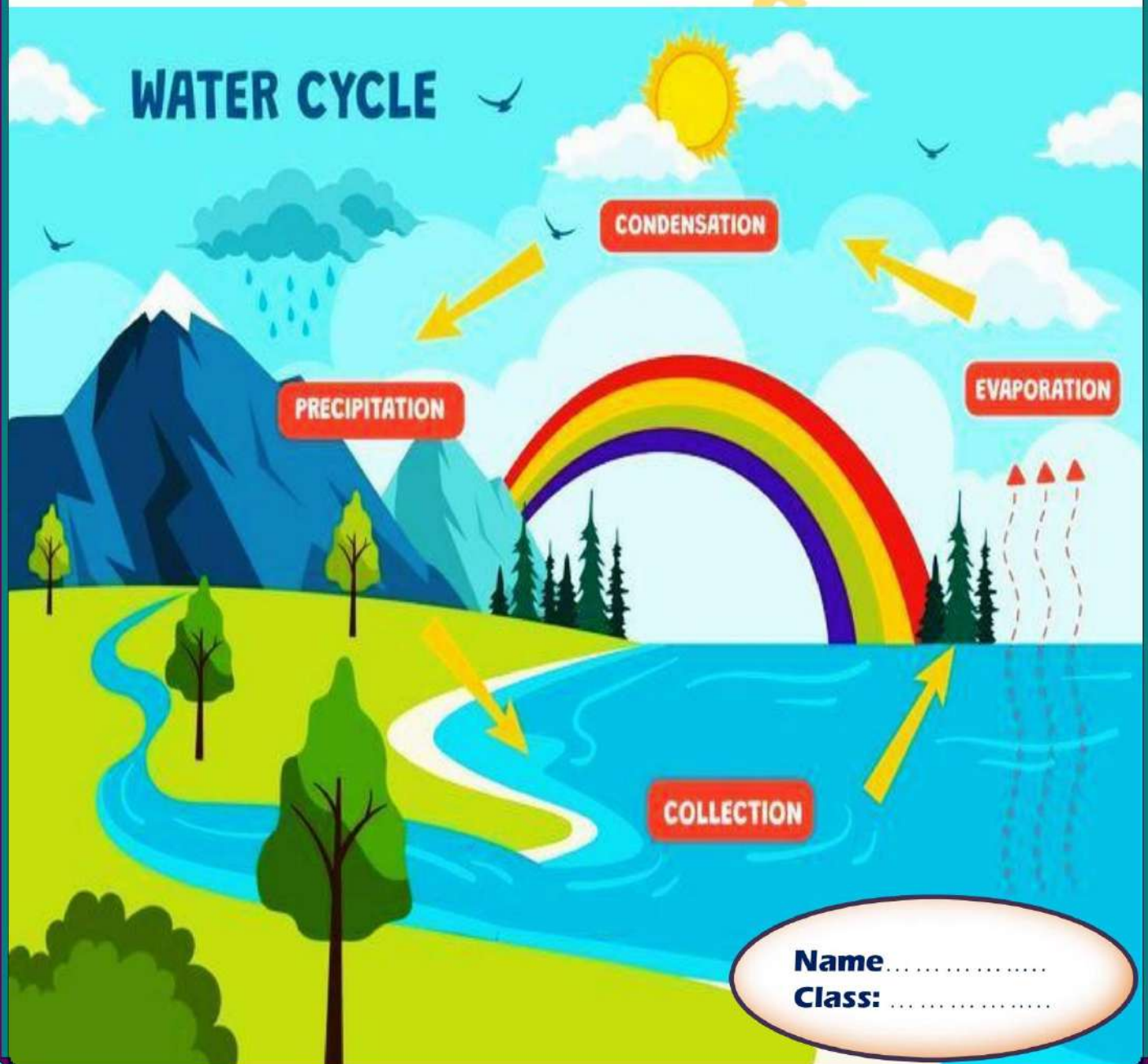
Geel 2000 Language Schools

Science Department

Sec. (1)

Integrated Science

Lesson (1), (2), (3)





Contents



Unit (1) :- (Aquatic system)

- 1-Hydrosphere on the planet earth.
- 2-Chemical properties of water.
- 3-Physical properties of water.
- 4-Solutions and their properties.
- 5-Biological importance of water.
- 6-Biological adaptations of L.O. in aquatic ecosystem.
- 7-The effect of atmosphere gases on the aquatic ecosystem.
- 8-The effect of light and radiation on aquatic ecosystem.
- 9-The effect of aquatic pressure on the L.O.
- 10-Environmental balance and the role of human in sustainability of aquatic life.



Unit (2) :- (Atmosphere)

- 1- Components and layers of the atmosphere.
- 2- Chemical reactions in the atmosphere.
- 3- Physical factors and their effect in the atmosphere.
- 4- Atmosphere and the role of science in the life sustainability.



Unit One Aquatic ecosystem

Lesson (1) :- Aquatic Ecosystem

***Environment:-** Everything surround us.

Environment word is derived from a French word called (Environ).

Components of the environment

1-Biotic Factors (Living factors) :-

Plants, animals, Human and micro-organisms (Bacteria and Fungi).

2- Abiotic Factors (Non-living factor):-

Light, air, water and soil (physical and chemical factors).

3- There is interactions between Living factors (biotic) and non -living factors (Abiotic) .

Biotic Factors



Vs

Abiotic Factors



****Environment is an integrated system, its components can't be Separated.**

*** This system consists of:**

Physical

Chemical

Biological factors



* Ecosystem:

It is a community of living organisms and non -living organisms that interact with each other to adapt with any change.

* The natural ecosystem consists of four interconnected spheres as:-

* Ecosystem:

Examples of ecosystems:

Aquatic – Deserts - Forests

Sphere of the natural environment

1- Hydrosphere

2- Atmosphere

3- Lithosphere

4- Biosphere



These spheres are in continuous changes and are affected by human activities.

Total amount of water on Earth's surface.

Water covers about 70%.

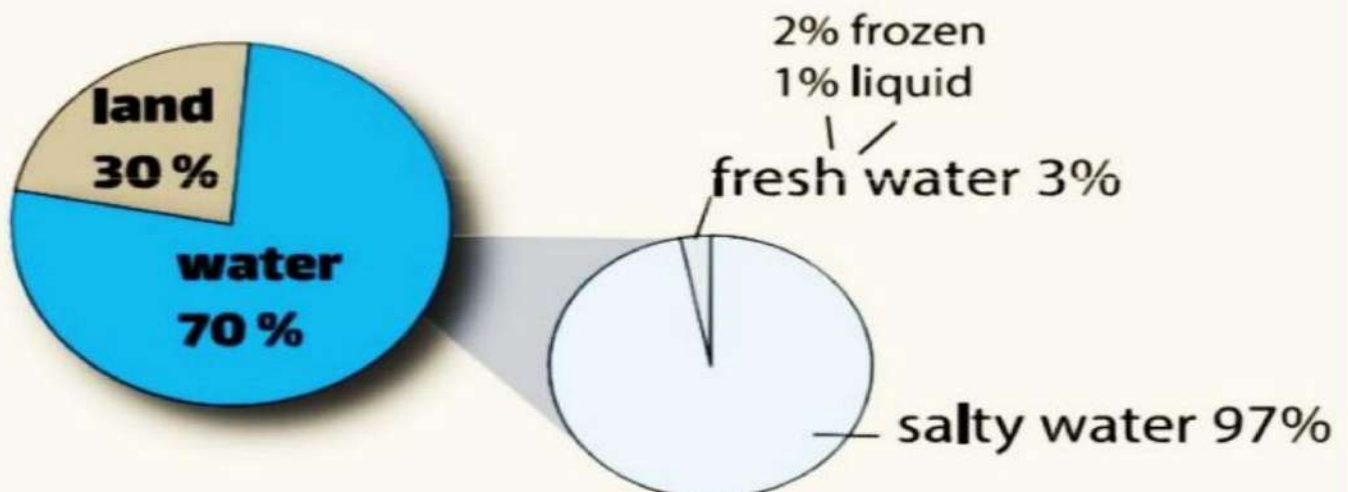
Land represents 30%

3% Fresh water

97% salty water
Found in oceans, seas,
and salt lakes.

1% fresh water
- rivers,
- Lakes
- Ground water
- Water tables

**2% Fresh water as
frozen water.**
- Polar ice caps
- Mountain peaks.
- Glaciated rivers.



Water cycle (hydrological cycle)

It is the continuous motion of water (present on the Earth's surface or near to it from a place to another around the Earth in closed system in the three states (solid, liquid and gaseous)).

*The water cycle as a system is capable of changing the Earth's surface **physically, chemically and biologically**.

The water cycle includes:-

1- Evaporation: It is the change of water from Liquid to gaseous state.

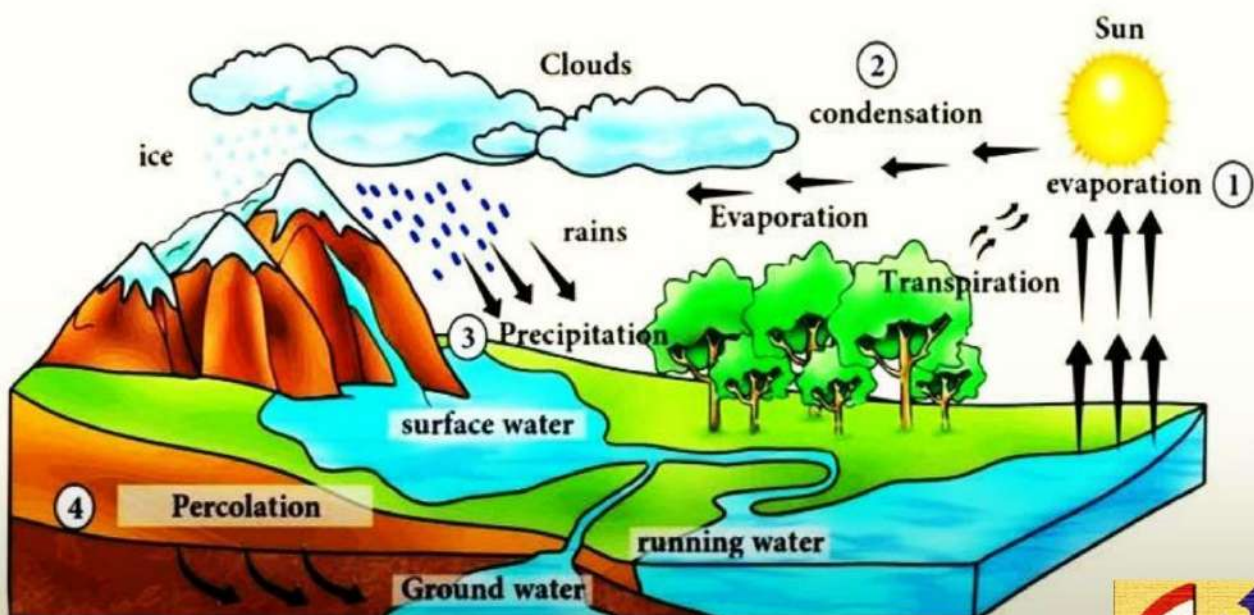
Evaporation processes as:

- * **Respiration** of plants and animals.
- * **Excretion** of plants and animals.
- * **Transpiration** in plants only.

2- Condensation: contributes to the formation of clouds.

3- Precipitation:- the process of rainfall or snow fall.

4- Percolation:- water leaks through soil pores and sedimentary rocks to Form ground water.



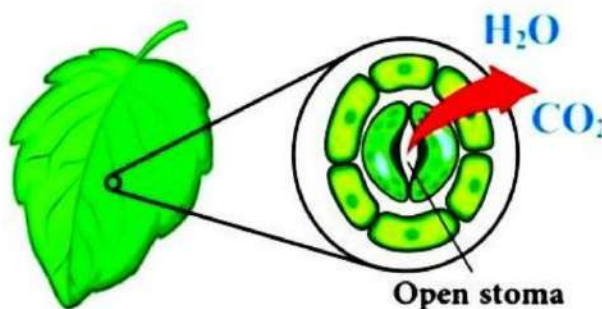
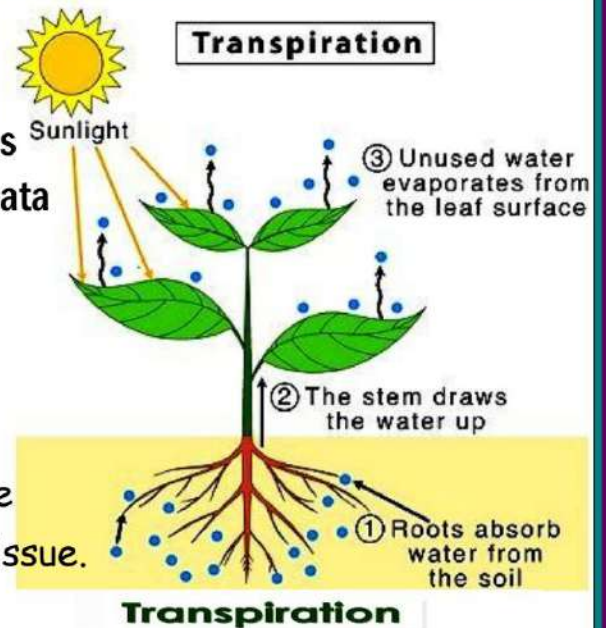
Supervisor: Mrs. Dalia Faray

Transpiration It is the loss of excess water in the form of water vapor from the plant surface.

Transpiration occurs through microscopic holes on the plant leaves and green stems called Stomata

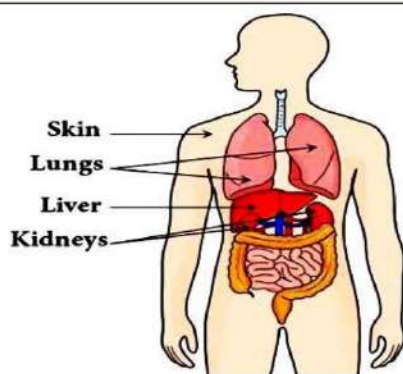
Importance of Transpiration:-

- 1- Decrease the temperature of the plant.
- 2- Transpiration creates force called **transpiration pull force**, Helps the plant to absorb water and salts from root to the upper parts of the plant through Xylem tissue.



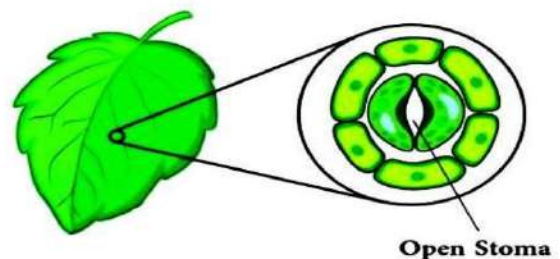
Excretion:- is the process in which the living organisms get rid of wastes produced from metabolism as carbon dioxide, water vapour and nitrogenous wastes (Ammonia, Urea and Uric acid).

In Human



- Respiratory organs: Lungs
- Excretory organs: Skin, lungs, liver, kidneys

In Plant



- Excretion and respiration: Stomata

Transpiration helps in lifting water and minerals from the soil through the xylem vessels that are found in the root and extend to the stem and leaves, as follows:

- 1 Evaporation of water through the stomata (transpiration).
- 2 Transpiration creates a pulling (suction) force as a result of water loss from the leaf.
- 3 The pulling force draws water upward through the xylem vessels.
- 4 Water passes from the root to the stem to compensate for the water lost from the leaves.
- 5 The plant absorbs new water from the soil, and the process is repeated.

Lesson (2) chemical properties of water

Water (H₂O) chemically:

- 1- Water is a transparent medium (**light passes through it**).
- 2- Water can dissolve many chemicals as **table salt**.

Water (H₂O) physically:

Water exists in three states of matter (**solid, liquid and gas**) within the temperature range known on Earth.

Three States of Water



Ice
(Solid)



Water
(Liquid)



Water vapors
(Gas)

Water (H₂O) biologically:

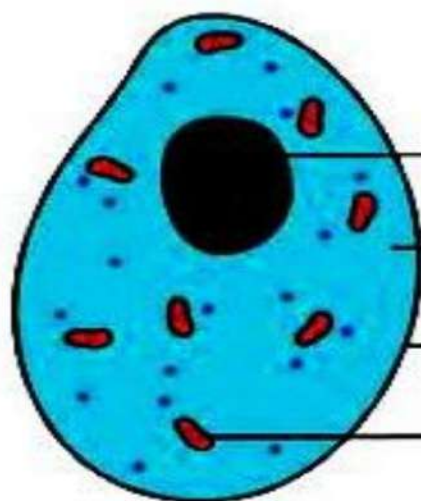
Water is essential for life continuity on the Earth. (**Explain**)

Because every cell of a living organism is surrounded by a **plasma membrane**.

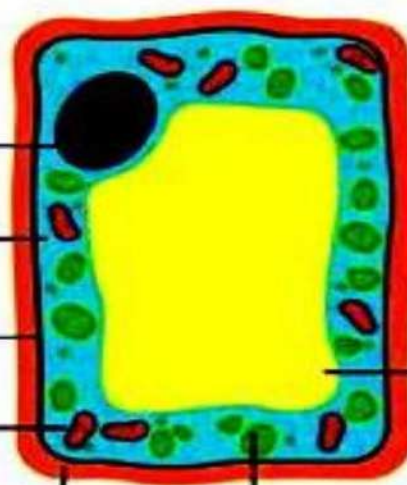
*** Water passes through plasma membrane to carry substances that needed by the organisms to produce energy.**

***Water removes wastes from inside the cell to outside the cell through plasma membrane.**

Animal cell



Plant cell



Nucleus

Cytoplasm

Cell membrane

Mitochondria

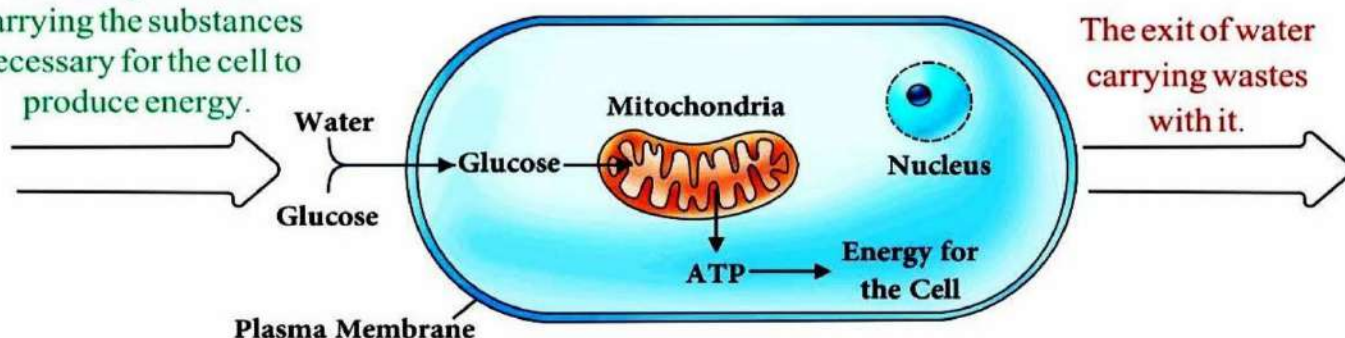
Vacuole

Cell wall

Chloroplasts



The entry of water carrying the substances necessary for the cell to produce energy.



Chemical structure of water:

★ **Water (H_2O) consists of 3 atoms (2 atoms of hydrogen and one atom of oxygen)**

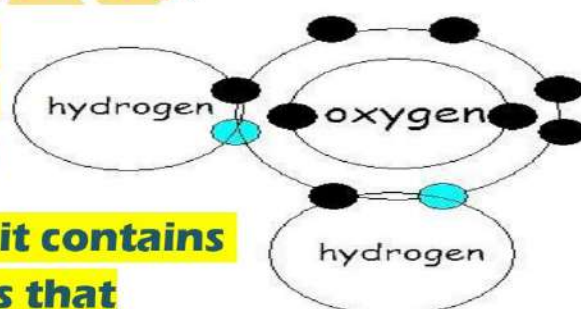
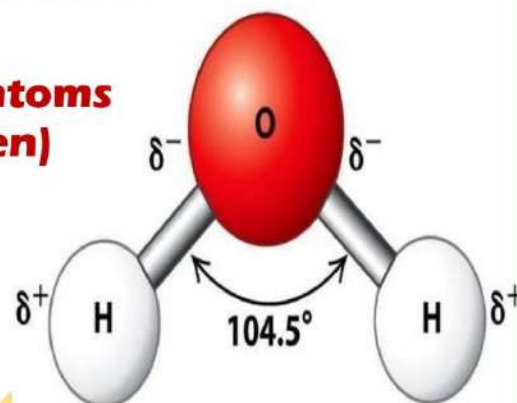
★ **The two hydrogen atoms are linked to the oxygen atom by two single covalent bonds, forming an angle about 104.5° between them.**

★ **The ratio between the mass of hydrogen and oxygen is 1:8 (respectively).**

★ **Oxygen represents 88.89%.**

★ **Hydrogen represents 11.11%.**

★ **Water does not exist on the Earth's surface in a pure form, as it contains many ions and chemical materials that interact with it in different ways.**



Covalent bond:-

It is the a type of chemical bond between two atoms each one share with one or more electrons to form the bond

Properties of water:

1-The polarity of water:

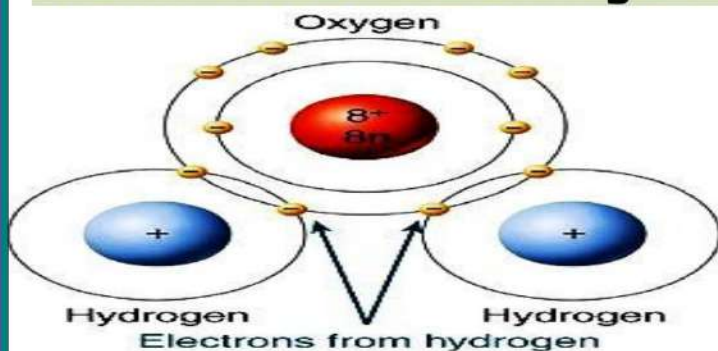
Water is a polar compound. (Explain)

Because oxygen is more electronegativity than the hydrogen atom.

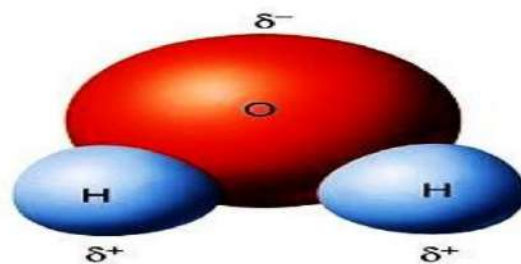
so the bond electrons are attracted towards the oxygen atom, forming a partial negative charge on the oxygen atom and a partial positive charge on the hydrogen atom.

Electronegativity

It is the ability of the atom to attract electrons of the chemical bond to itself longer time.



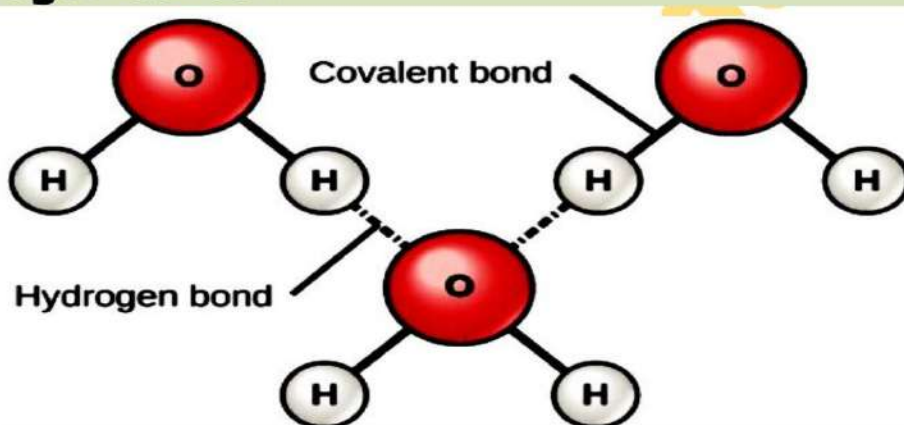
(a) Electron shells in a water molecule



(b) Distribution of partial charges in a water molecule

The polarity of the water molecule causes:-

The connection of water molecules with each other in what by hydrogen bonds .



Each water molecule may be surrounded by four hydrogen bonds with neighboring water molecules forming a web of Hydrogen bonds give the unique properties of water.

Hydrogen bond

It is the electrostatic attraction between the partially +ve charge of hydrogen in a water molecule and the partially negative charge of oxygen in another neighboring atom.

Results of water polarity

- 1-Forming hydrogen bonds with polar molecules of other materials, which gives water the ability to dissolve many salts and break them down into hydrated ions.
- 2- The rising of boiling point of pure water, which reaches 100°C under normal atmospheric pressure compared to the boiling point of compounds similar to it in composition such as hydrogen sulphide, which boils at (-61°C)

	Water	Hydrogen Sulfide
Chemical Formula	$\begin{array}{c} \cdot\cdot \\ \text{O} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \cdot\cdot \\ \text{S} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{H} \end{array}$
Electronegativity of the Central Atom	High	Low
Hydrogen Bonds	Exist between water molecules	Do Not Exist
Molecular Mass	Low	High
Boiling Point	100°C	-61°C
Type of Bonds between its Atoms	Two Covalent Bonds	

2-Water is a common solvent

Water has the ability to dissolve polar covalent compounds and ionic compounds as water is a polar compound.

What happen when adding of ionic compound (table salt) to water.

When ionic compounds are added to water

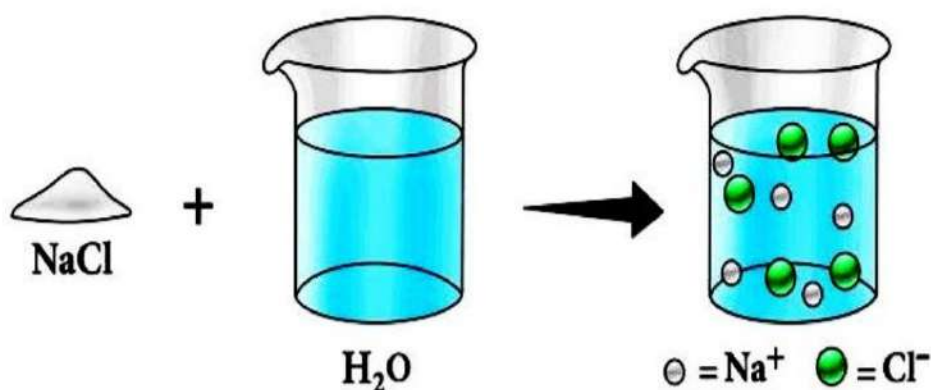
The crystal lattice dissociates into free ions surrounded by water molecules.

Water molecules prevent the ions from recombining.

Negative ions are attracted to the positive pole of water molecules (hydrogen atoms).

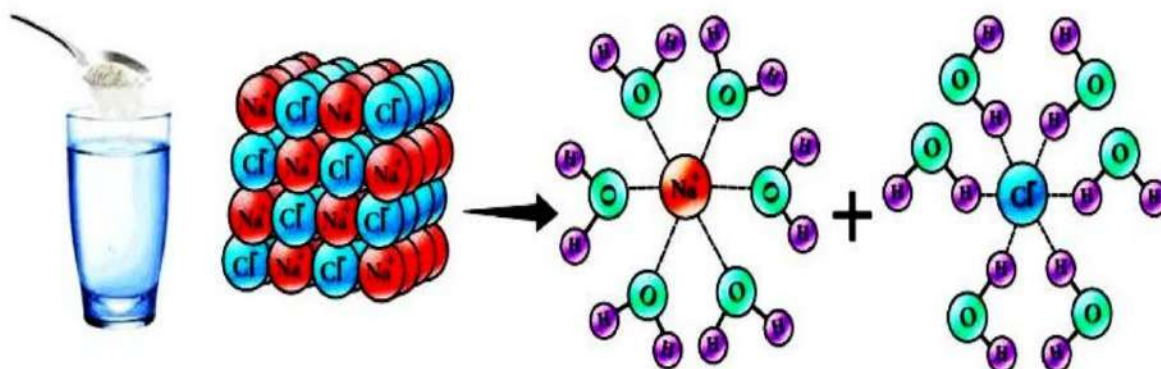
Positive ions are attracted to the negative pole of water molecules (oxygen atoms).

- Example: The dissolution of sodium chloride (table salt) in water.



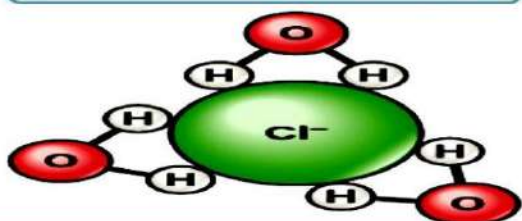
2
The positively charged sodium ion is surrounded by the partial negative charge of the oxygen atoms in the surrounding water molecules.

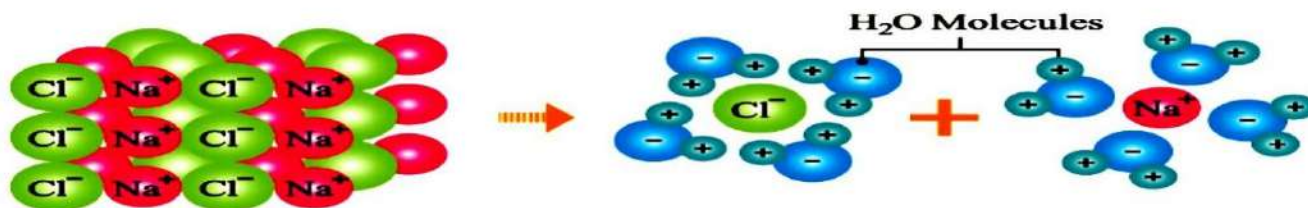
2
The negatively charged chloride ion is surrounded by the partial positive charge of the hydrogen atoms in the surrounding water molecules.



1
When sodium chloride crystals (an ionic compound), are added to water, the sodium chloride molecules dissociate into ions (Na^+) and (Cl^-), and the water molecules surround the ions.

3
The salt ions remain in the solution without binding to the water ions; therefore, the dissolution of sodium chloride in water is not considered hydrolysis, because the ions resulting from the dissociation of the salt do not react with water to form new acids or bases.



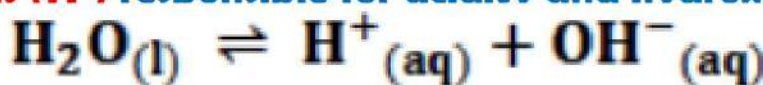


3-The ionic equilibrium of water.

Pure water ionizes very slightly.

Because some of water molecules dissociate to form:

Hydrogen ions (H^+) responsible for acidity and hydroxide ions (OH^-) alkalinity.



These ions are present in equal concentrations which makes pure water neutral.



Responsible for Alkalinity



Responsible for Acidity

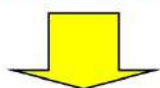
4-Water Hydrolysis of salts:

Hydrolysis

- * It is a reaction occurs when dissolving a solid salt in water forming an **acid and a base**.
- * One of them or both are weak.



Types of salts according to hydrolysis

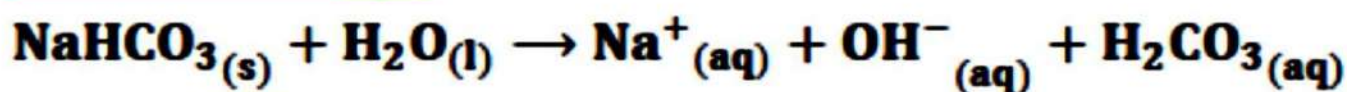


P.O.C.	1-Acidic salt	2-Basic salts	3- Neutral salts
1. When dissolving in water	Hydrolyzed	Hydrolyzed	Hydrolyzed
2- Concentration of Hydrogen ions (H^+)	Increase	Decrease	Not affected
3- Concentration of Hydroxide ions (OH^-)	decrease	Increase	Not affected
4-Examples	Dissolving of Ammonium chloride in water.	Dissolving of Sodium bicarbonate in water.	Dissolving of Ammonium bicarbonate in water.

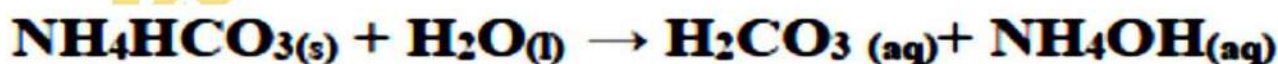
Acidic salts (NH_4Cl)



Basic salts ($NaHCO_3$)

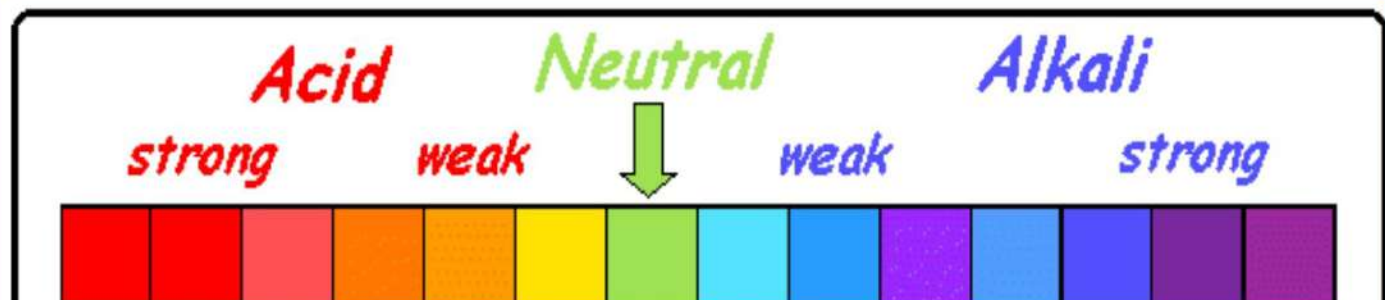


Neutral salts (NH_4HCO_3)

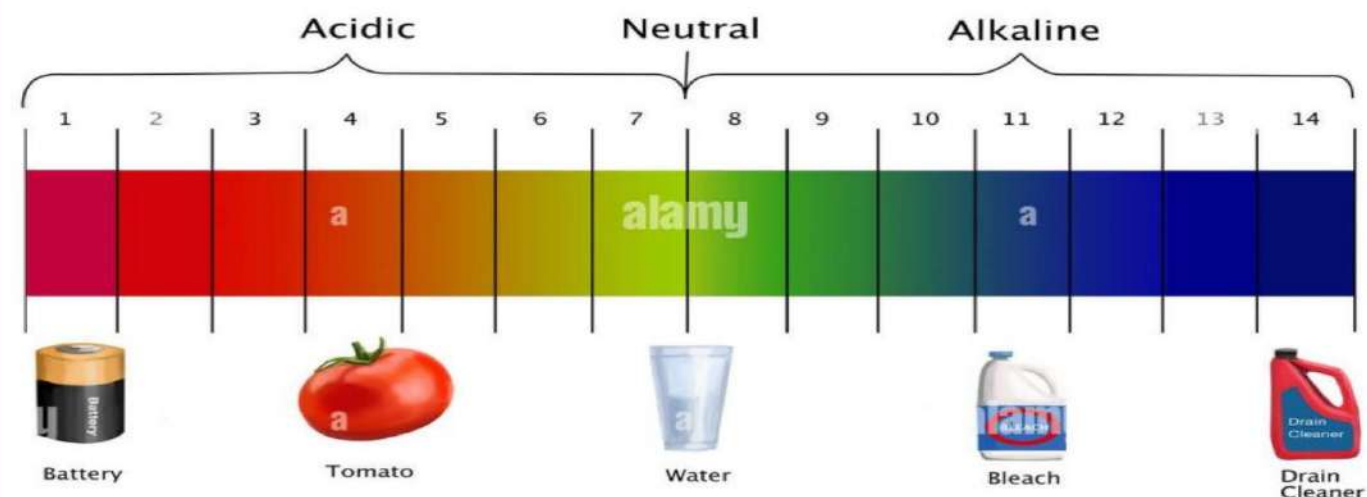


The pH value :

It is a graduated measurement from 0 to 14 that expresses the acidity, alkalinity or neutrality of the solution.



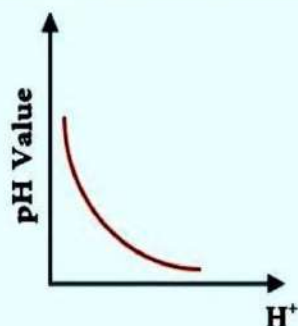
The PH Scale



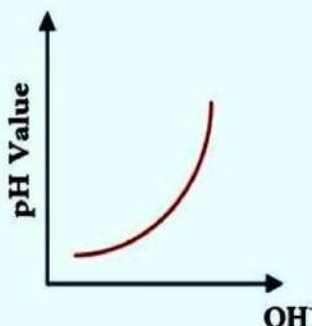
• Water can be classified according to the pH value as follows:

Nature of Water	Acidic	Neutral	Alkaline
pH Value	Less than 7	Equal to 7	Greater than 7
Ion Concentration in Water	Increase in H^+ concentration Acidic Solution	$H^+ = OH^-$ Neutral Solution	Increase in OH^- concentration Alkaline Solution

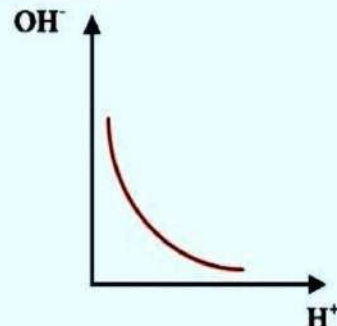
The relation between hydrogen concentration and the pH value.



The relation between hydroxide concentration and the pH value.



The relation between the concentration of hydrogen and hydroxide in the solution.



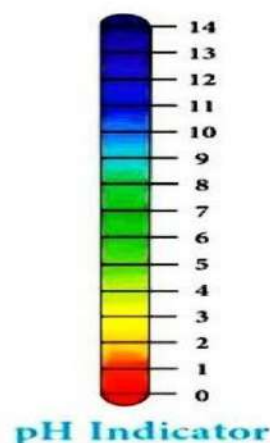
Measuring the variation of pH in different water samples:

By using pH meter or

pH indicator strips

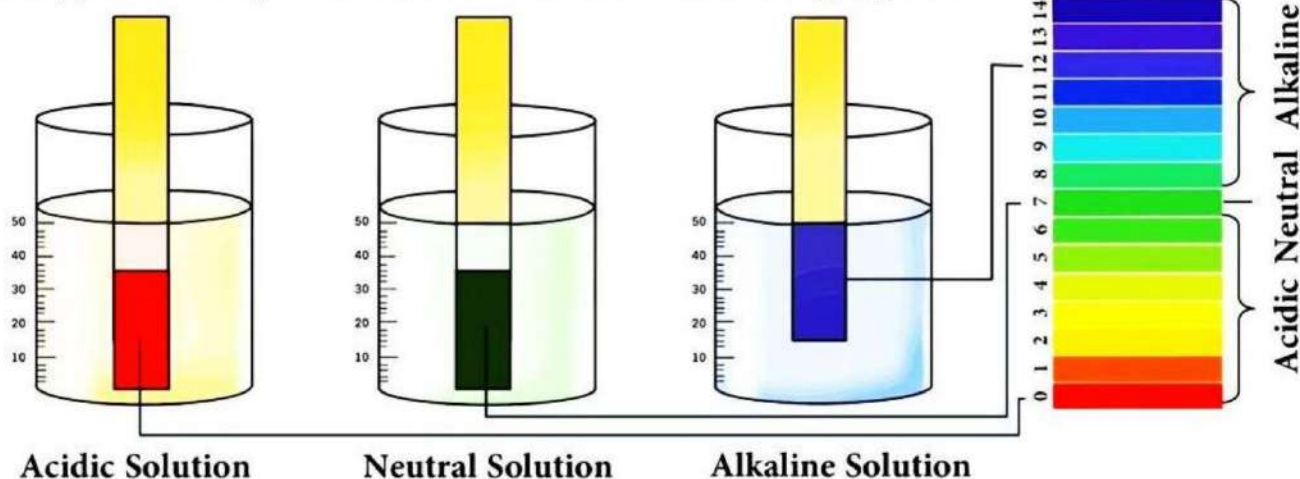


pH Meter



pH Indicator

When using pH test strips, the strip changes color according to the solution (acidic - basic - neutral). The strip is then compared with the provided chart to determine the approximate pH value, as shown in the following figure:



Acidic Solution

Neutral Solution

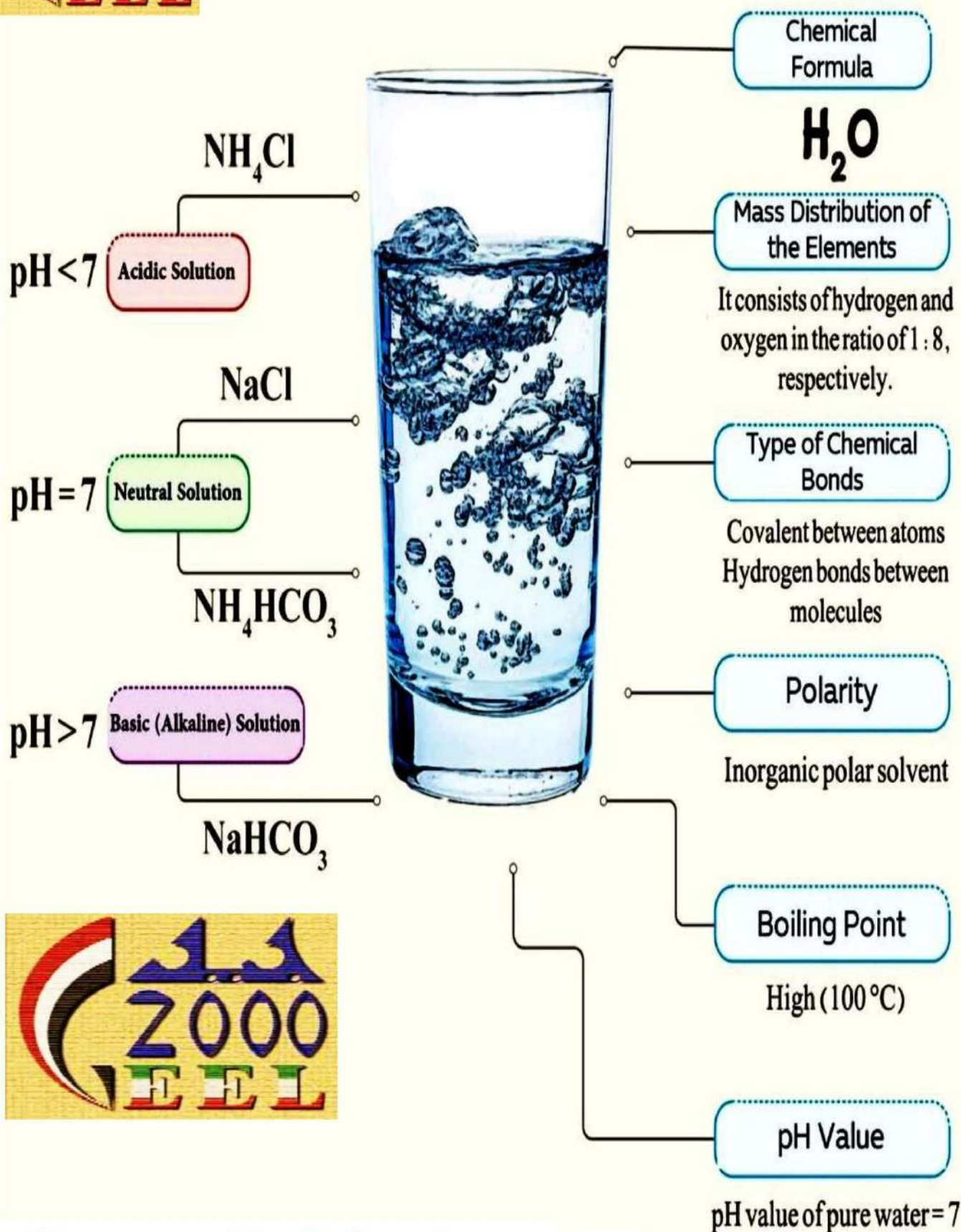
Alkaline Solution

Substance		pH Value
Pure water (Distilled water)		7
Sea water		Ranges from 7.5 to 8.4
Fresh water	Rivers	Ranges from 6.8 to 7.8
	Lakes	Ranges from 7.3 to 8.5
Ground water		Ranges from 6 to 8.5
Clouds		Ranges from 4.5 to 5
Mine water		Ranges from 3 to 4

- The values presented in the table are approximate and may vary depending on different environmental factors and human activities in the area, which affect the pH value of the water.



Properties of Water

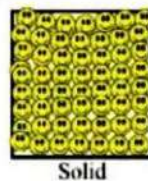
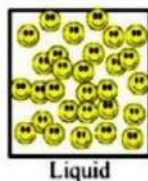
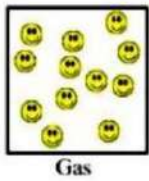


Lesson (3)

The physical properties of water and their role in the distribution of living organisms

1. DENSITY:

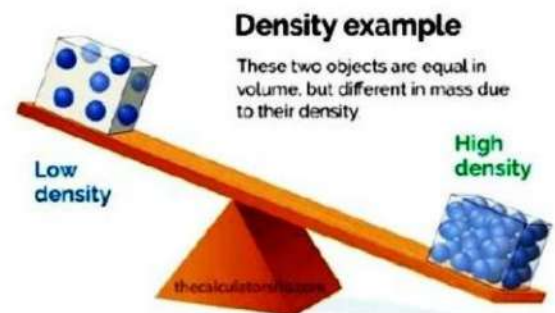
Mass per unit volume of a substance at a specific temperature



Water's density depends on

- Mass of its molecules .
- Spaces between molecule.

$$\rho = \frac{m}{Vol} \rightarrow kg/m^3$$



RELATIVE DENSITY:

The ratio of its density to the density of water at the same temperature.

$$\rho_r = \frac{\rho_m}{\rho_w} \rightarrow \text{Unitless}$$

HYDROMETER

Instrument used to measure the density or relative density of liquids.

Hydrometer consists of

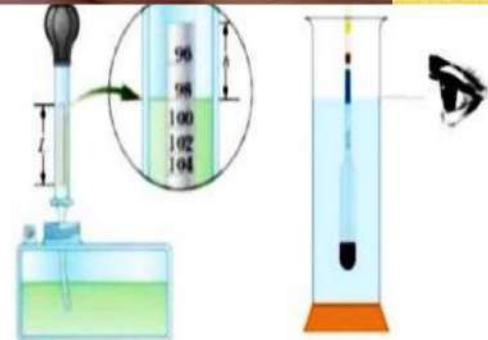
- A sealed, hollow glass tube with a wider base for buoyancy.
- Lead or mercury balls at the bottom for balance.
- A long, thin, graduated stem to indicate density readings.



How to Use a Hydrometer



- The lower scale on the hydrometer shows the highest density it can measure.
- The upper scale shows the lowest density it can measure.

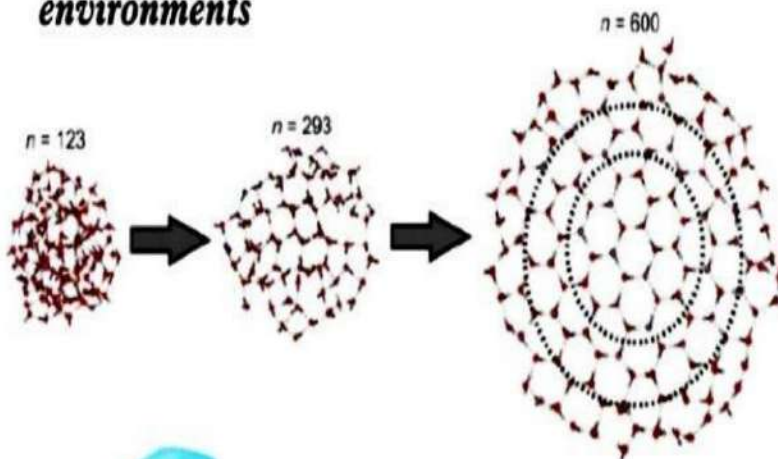


Physical Properties of Water:

Water has unique physical properties that distinguish it from other fluids (liquids and gases):

1. The decrease in its density when it freezes

2. The increase in its specific heat, which affects many natural phenomena and the distribution of living organisms in different environments

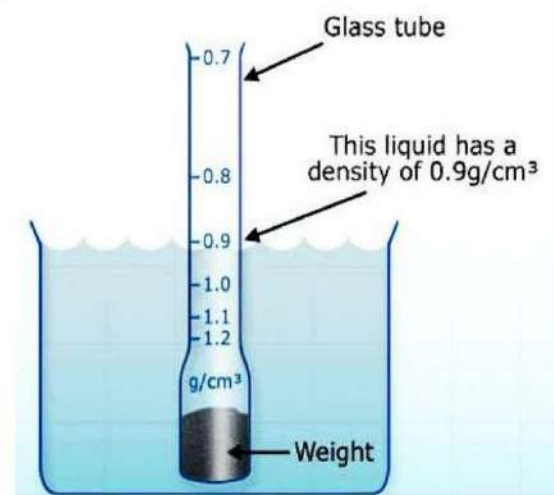


liquid



solid

Hydrometer



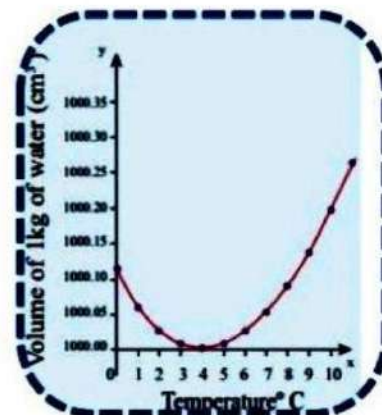
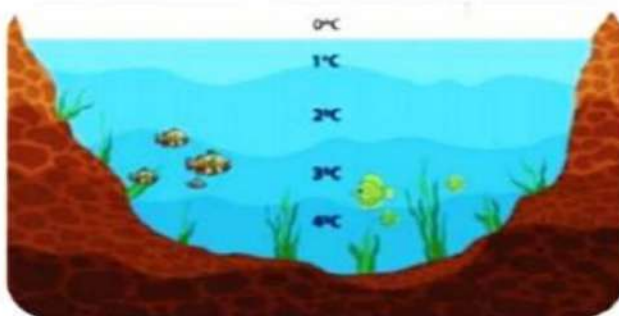
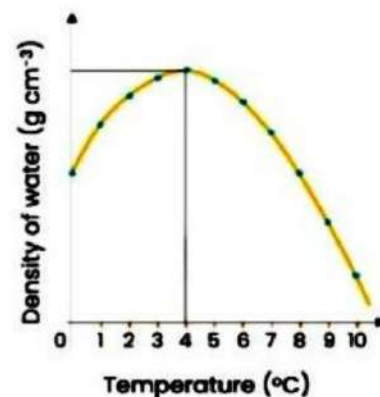
Density of water in Polar Regions



- Generally, the volume of liquids increases with rising temperature and decreases with lowering temperature.
- **Water Exception:**
 - From 0°C to 4°C , water shrinks as temperature increases, and its density increases.
 - Water reaches its highest density (1000 kg/m^3) at 4°C .
 - Above 4°C , water expands, and its density decreases.

EXPLANATION IN POLAR REGIONS (FREEZING OF LAKES)

- As air temperatures drop between 4°C and 0°C , surface water expands and becomes less dense than the water below.
- The surface water freezes first, and the ice remains on top because it is less dense than liquid water.
- Water at 4°C stays at the bottom, allowing fish and other marine life to survive under the ice.
- As the temperature of the water decreases until it reaches 4°C → the molecules get closer together → occupy less volume → their density increases.
- When the water temperature drops below 4°C → its density decreases



Water Density and Ocean Currents



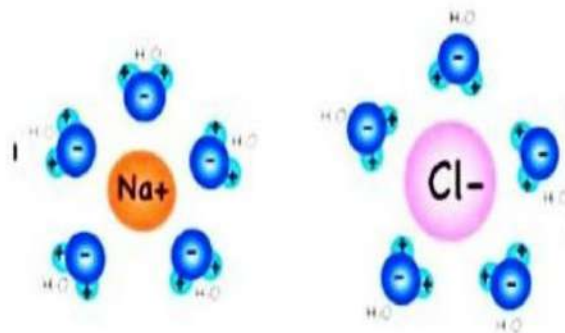
FACTORS AFFECTING WATER DENSITY:

1. Pressure:

- As pressure increases with depth in the ocean, water molecules are forced closer together, increasing density.
- In shallow water, the density of water does not change with increasing depth **because it is incompressible.**

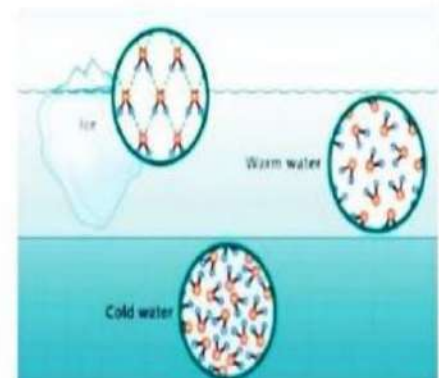
2. Salinity (Amount of Dissolved Salt):

- The more salt in the water, the higher the density.
- Average ocean salinity: 35 grams of salt per liter (about 2 teaspoons of salt per cup of water).



3. Temperature:

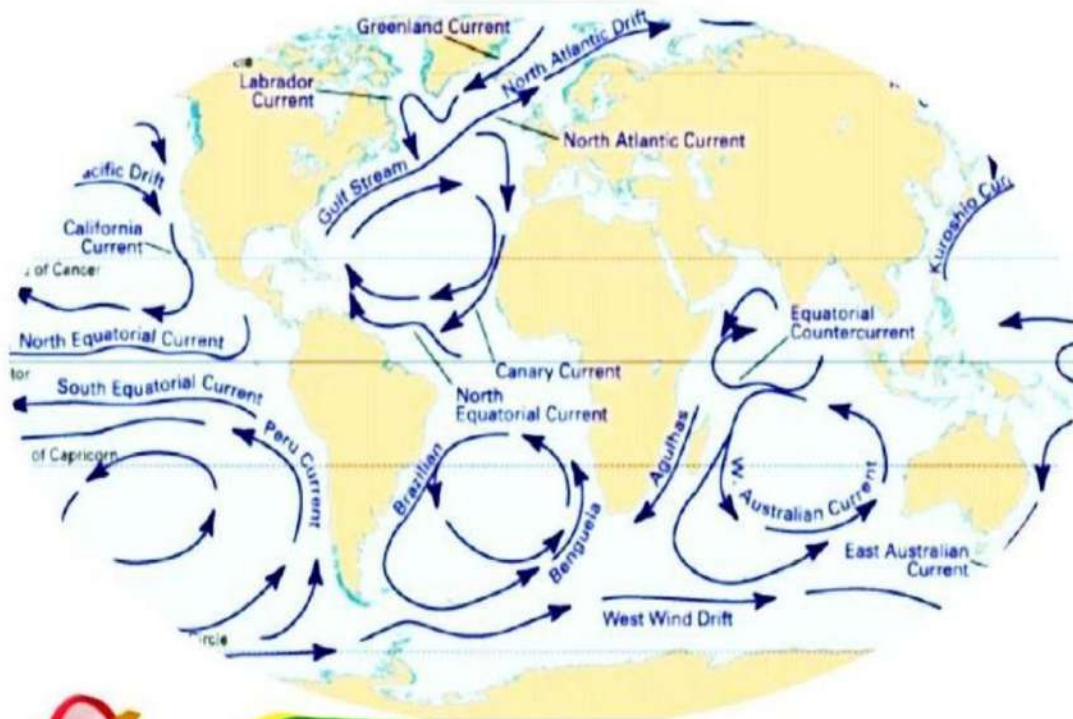
- As water cools, its molecules move closer together, increasing density.
- Water reaches maximum density at 4°C before it starts to freeze.



IMPORTANCE OF WATER DENSITY IN OCEAN CURRENTS.



1. *Density differences drive the movement of ocean currents.*
2. *These currents play a critical role in:*
 - *Transporting heat and salt from tropical regions to the poles.*
 - *Moving nutrients from the deep ocean to the surface, supporting marine life.*
 - *Carrying fresh water from rivers and melting glaciers to various parts of the ocean.*



Note

When freshwater from melting icebergs or glaciers enters the ocean (saltwater), that freshwater spreads on the surface of the ocean and does not sink where this freshwater might freeze on the surface forming a thermal insulator between the deeper parts of the ocean and the cold atmospheric air above.



2. QUANTITY OF HEAT + TEMPERATURE



- Any system contain large number of molecules, separated by space.

This molecules have energy divided to

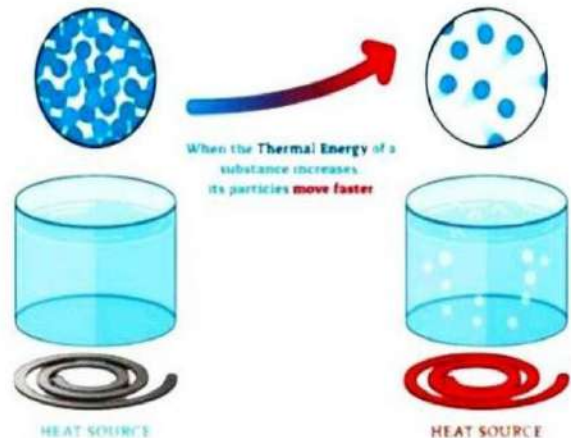
- Potential energy
 - resulting from the position of the particles relative to each other
- Kinetic energy
 - resulting from the motion of the particles



THE SUM OF THEM CALLED INTERNAL ENERGY

QUANTITY OF HEAT

- it is the total amount of thermal energy present in a system.
- It is often measured in joules (J) or calories (Cal). It's a measure of the total thermal energy transferred between two systems.



TEMPERATURE

it is a measure of the average kinetic energy of the particles in a substance, indicating how hot or cold something is



Note

When a body or system acquires an amount of thermal energy, the amplitude of vibration of its molecules increases, as does their kinetic energy, and thus its temperature rises.



QUANTITY OF HEAT

THERMAL ENERGY OF PARTICLE



TEMPERATURE

KINETIC ENERGY OF THE PARTICLES



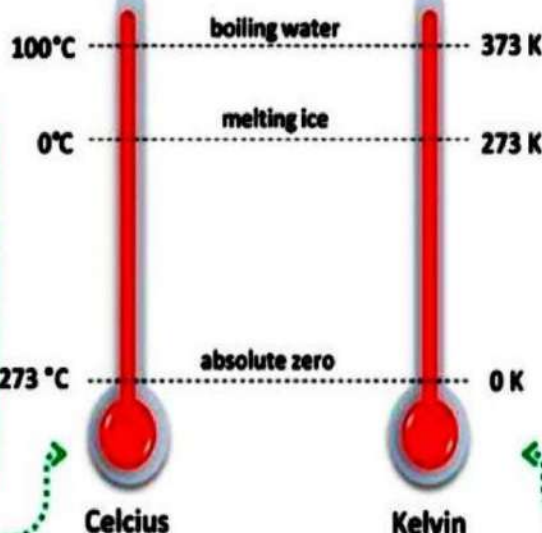
How Measure temp.:

- It is typically measured in degrees Celsius (C), degrees Fahrenheit (°F), or Kelvin (K).
- It's a measure of the intensity of heat, not the total amount

Celsius to Kelvin
 $K = ^\circ C + 273.15$

Kelvin to Celsius
 $^\circ C = K + 273.15$

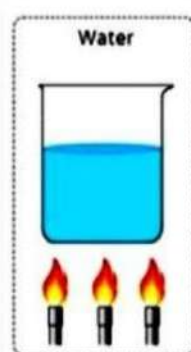
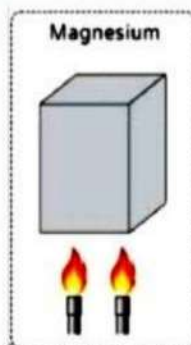
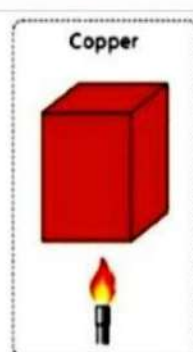
Celsius (C): This is the most used temperature scale in everyday life. It is based on the freezing point of water, which is defined as $0^\circ C$, and the boiling point of water, which is defined as $100^\circ C$.



Kelvin (K): This is an absolute temperature scale, meaning its zero point represents the lowest possible temperature that can be reached (absolute zero). This is equivalent to $-273^\circ C$.

$$\Delta t(^{\circ}C) = \Delta T(K)$$

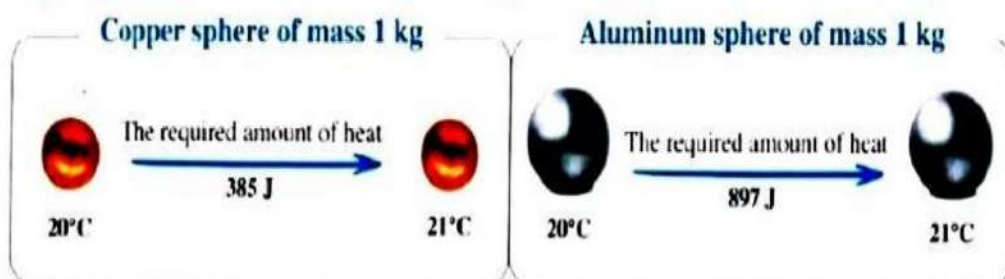
DOES A UNIT OF MASS (1 KG) OF DIFFERENT SUBSTANCES REQUIRE THE SAME AMOUNT OF HEAT FOR THEIR RESPECTIVE TEMPERATURES TO RISE BY ONE KELVIN



3. THE SPECIFIC HEAT

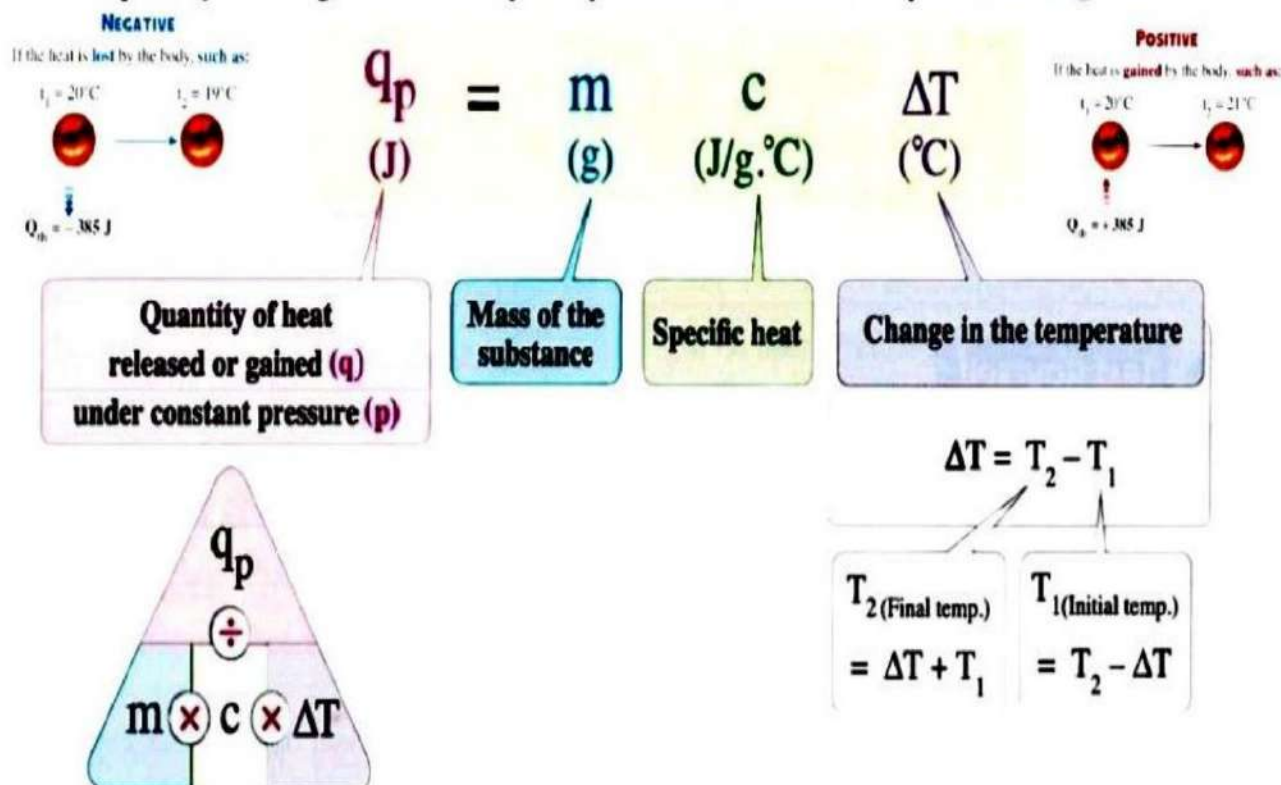


- amount of heat required to raise the temperature of one unit of mass of the substance by one unit of temperature.
- Units: Common units for specific heat are joules per kilogram per Kelvin (J/kg.K)
- depend on type of material and impurities and state
- Water's high specific heat: Water has a particularly high specific heat, meaning it takes a lot of heat energy to raise its temperature. *(This property is essential for regulating Earth's climate)*



Calculation of the quantity of heat

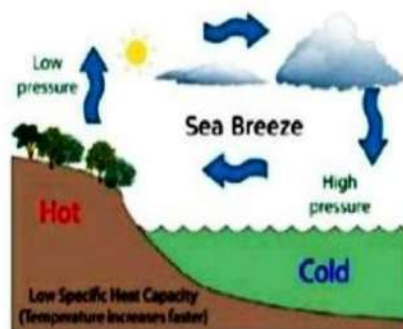
* The quantity of heat gained or lost by the system can be calculated by the following relation :



4. SEA BREEZE



The temperature of a large body of water during the summer is low compared to the temperature of beach sand and rocks. **Air over land heats up**, becomes **less dense**, and rises upward. **Cooler air** from above the surface of the water moves landward, and is called the **sea breeze**, to replace the hot air that has risen upward.



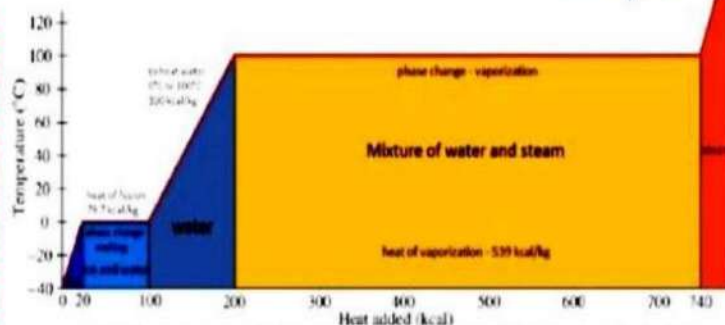
5. LATENT HEAT OF SUBLIMATION

The latent heat of vaporization is the thermal energy absorbed by a unit **mass (1 kg)** of a substance to change from the liquid state to the gaseous state (**vapor state**) without a change in temperature.

(OR RELEASED DURING ITS CHANGE FROM THE GASEOUS STATE (VAPOR) TO THE LIQUID STATE WITHOUT A CHANGE IN TEMPERATURE).



This is useful for many organisms, as they can use **water evaporation** as a mechanism to regulate their body temperature. When organisms **sweat or transpiration** occurs in plants, the evaporated water molecules carry heat away from the body.



WATER HAS A HIGH LATENT HEAT DUE TO THE HYDROGEN BONDS BETWEEN ITS MOLECULES. FOR WATER TO EVAPORATE, THE HYDROGEN BONDS BETWEEN ITS MOLECULES MUST BE BROKEN, WHICH REQUIRES A LOT OF ENERGY.

6. THE EFFECT OF TEMPERATURE CHANGES ON MARINE ORGANISMS:



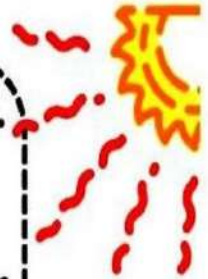
Temperature is a critical factor that influences the distribution, and behavior, of marine organisms that live in warm surface waters may be unable to survive in colder depths.

HIGH SPECIFIC HEAT OF WATER

1. Water can absorb a lot of heat without getting much hotter. This helps keep ocean temperatures stable.

2. **Oceans as Heat Reservoirs:** Oceans and lakes store a lot of heat during the day and release it slowly at night.

THIS HELPS KEEP TEMPERATURES IN THE SURROUNDING MARINE ENVIRONMENT STABLE.



Note

Coral reefs need specific temperatures to survive

POIKILOTHERMS

This property protects marine organisms from rapid changes in temperature. especially cold-blooded creatures

Cold-blooded organisms

such as most vertebrates such as fish, amphibians, and reptiles, and all invertebrates such as arthropods and mollusks, depend on external sources, such as sunlight or warm environments, to regulate their body temperature, which changes with the surrounded temperature.

whose body temperature depends on the temperature of the surrounding environment.

For this reason, we often find these organisms in the deep seas and oceans where the temperature is stable.

Warm-blooded animals, such as birds and mammals, can maintain a constant temperature inside their bodies through metabolic processes regardless of the temperature of the surrounding environment.

